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Candidate surname

Other names

Centre Number

Candidate Number

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## Pearson Edexcel International Advanced Level

Time 1 hour 20 minutes

Paper  
reference

**WCH13/01**

### Chemistry

International Advanced Subsidiary/Advanced Level

**UNIT 3: Practical Skills in Chemistry I**

**You must have:**

Scientific calculator, ruler

Total Marks

### Instructions

- Use **black** ink or **black** ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided  
– *there may be more space than you need.*

### Information

- The total mark for this paper is 50.
- The marks for **each** question are shown in brackets  
– *use this as a guide as to how much time to spend on each question.*
- You will be assessed on your ability to organise and present information, ideas, descriptions and arguments clearly and logically, including your use of grammar, punctuation and spelling.
- There is a Periodic Table on the back cover of this paper.

### Advice

- Read each question carefully before you start to answer it.
- Show all your working in calculations and include units where appropriate.
- Check your answers if you have time at the end.

Turn over ►

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Answer ALL questions. Write your answers in the spaces provided.

1 This question is about some compounds of strontium.

(a) State a test for the strontium cation, giving the expected result.

(2)

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(b) An unlabelled bottle was thought to contain solid strontium chloride.

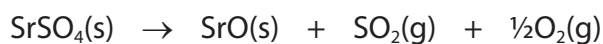
A sample of the solid was dissolved in distilled water for tests to identify the anion.

Complete the table to give the expected results of the anion tests.

(2)

Reagent added for test	Expected result for the strontium chloride solution
Barium chloride acidified with hydrochloric acid	..... .....
Silver nitrate acidified with nitric acid	..... .....

(c) Anhydrous strontium sulfate undergoes thermal decomposition at approximately 1300 °C.



Suggest why this decomposition is unlikely to be possible in a school laboratory.

(1)

.....

.....

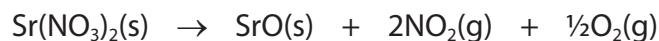
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(d) Anhydrous strontium nitrate decomposes at 570°C.



(i) Describe how to ensure the strontium nitrate decomposes fully. (1)

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.....

(ii) State the colour of nitrogen dioxide gas. (1)

.....

(iii) Give the test for oxygen and the expected positive result. (1)

.....

.....

(iv) The solid residue from the decomposition was added to distilled water.  
Give **one** observation for the reaction that takes place, identifying the product of the reaction by name or formula. (2)

Observation

.....

.....

Product

.....

**(Total for Question 1 = 10 marks)**

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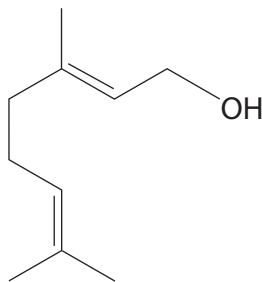


2 Geraniol is used in perfumes and can be extracted from many plants.

Data on geraniol are shown.

Solubility in water	Melting temperature/ $^{\circ}\text{C}$	Boiling temperature/ $^{\circ}\text{C}$	Density/ $\text{g cm}^{-3}$
insoluble	-15	230	0.889

The structure of geraniol is shown.



(a) Geraniol has **two** different types of functional group.

**Name** the functional groups, giving a chemical test and its positive result to show the presence of each group.

(4)

First functional group:

.....

.....

.....

.....

Second functional group:

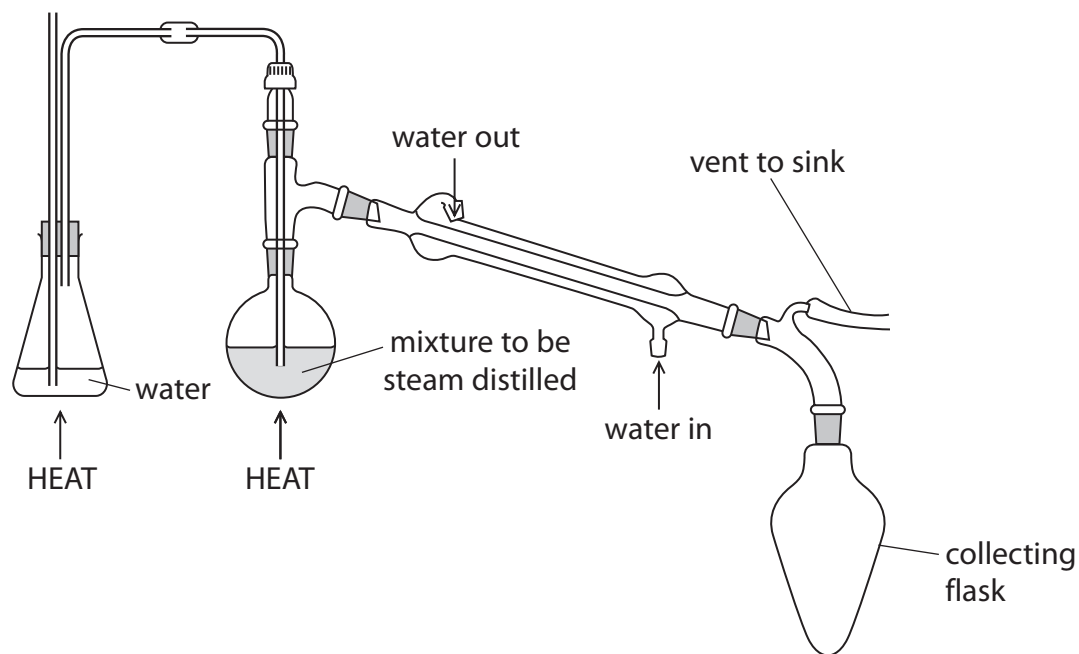
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(b) Geraniol is extracted by steam distillation.



The steam distillation product is geraniol and water. The water may contain dissolved impurities which have similar boiling temperatures to geraniol.

The contents of the collecting flask are transferred to a piece of apparatus used to separate the geraniol from the water layer.

Draw a labelled diagram of this apparatus and its contents.

(3)

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(c) The geraniol will still contain small quantities of water.

Describe how to produce a sample of pure, dry geraniol using a named drying agent.

(3)

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.....

.....

.....

(d) The hazard labels for pure geraniol are shown.

		
.....	.....	.....

(i) Complete the table to identify the hazards indicated by the symbols.

(2)



- (ii) State **one** precaution, other than wearing safety spectacles and a laboratory coat, that should be taken when using pure geraniol to reduce the risk associated with the hazard symbol shown.



(1)

- (e) State the appearance of the flame when geraniol is ignited.

(1)

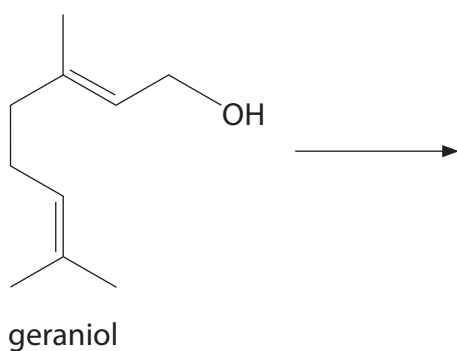
- (f) Geraniol reacts with **excess** hydrogen gas.

- (i) State the essential condition required for this reaction.

(1)

- (ii) Draw the **skeletal** formula of the product of this reaction.

(1)



(Total for Question 2 = 16 marks)



- 3 A student carried out experiments to determine the enthalpy change for the hydration of anhydrous copper(II) sulfate,  $\text{CuSO}_4$ , to form hydrated copper(II) sulfate crystals,  $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ .

To find the enthalpy change of solution of anhydrous copper(II) sulfate,  $25.0\text{ cm}^3$  of distilled water was placed in a polystyrene cup and the temperature measured at one minute intervals.

After 2.5 minutes, 7.50 g of anhydrous copper(II) sulfate was added and the mixture stirred continuously.

The results are shown.

Time / minutes	0	1	2	2.5	3	4	5	6	7	8
Temperature / °C	21.1	21.0	21.0	X	34.2	37.6	36.9	36.1	35.2	34.3





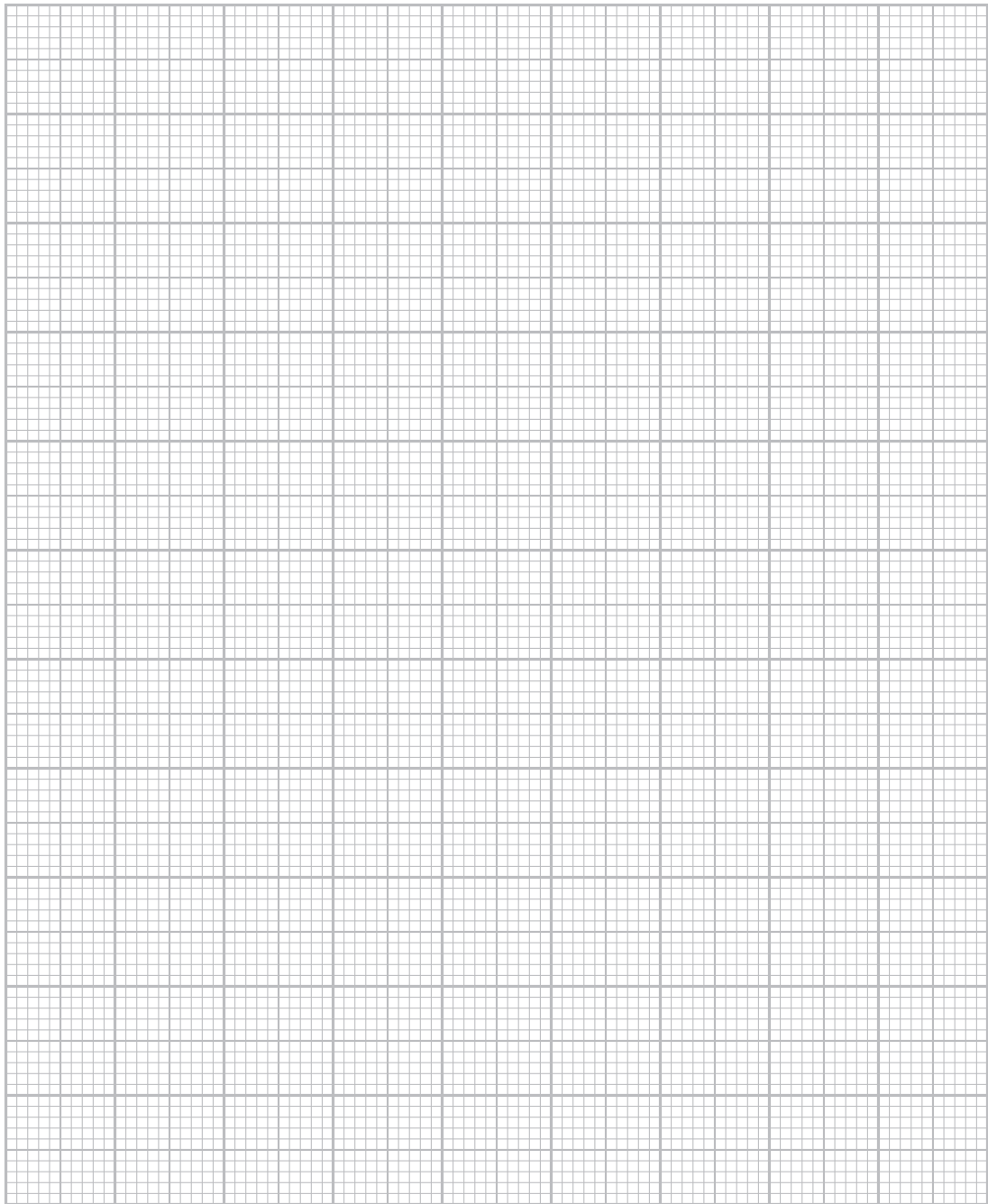
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(a) Plot a graph of temperature against time on the grid.

(3)



(b) Determine the maximum temperature change,  $\Delta T$ , using your graph.

You **must** show your working on the graph.

(2)

$\Delta T = \dots\dots\dots$



(c) The value of the enthalpy change from this experiment was  $-39.0 \text{ kJ mol}^{-1}$ .

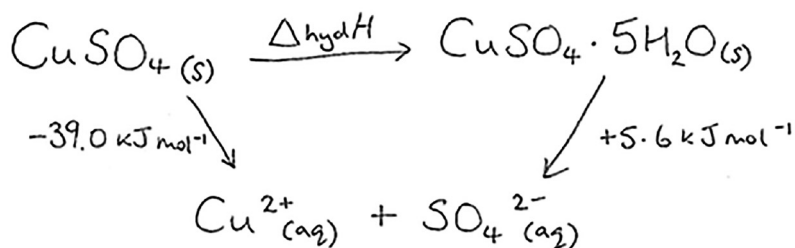
Give **one** possible reason why this value is different from a data book value of  $-61.4 \text{ kJ mol}^{-1}$ .

(1)

(d) After another experiment to find the enthalpy change of solution of hydrated copper(II) sulfate crystals, the student constructed the Hess cycle shown.

(i) Calculate the enthalpy change of hydration for the conversion of anhydrous copper(II) sulfate to hydrated copper(II) sulfate crystals.

(1)



(ii) Give **one** possible reason why the enthalpy change of hydration in (d)(i) could **not** be found directly by experiment.

(1)

(Total for Question 3 = 8 marks)



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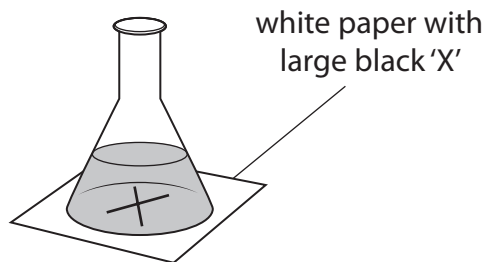
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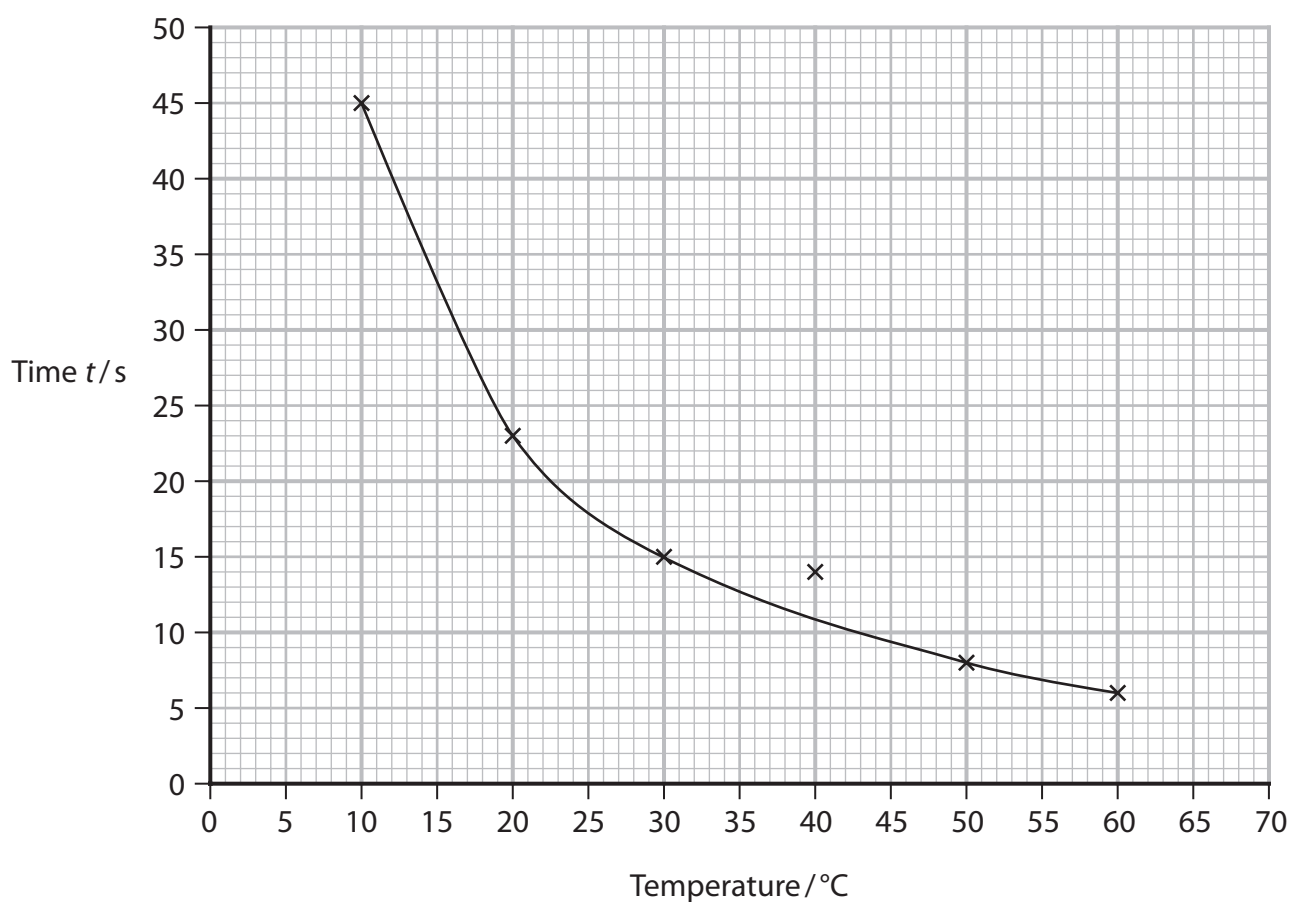


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- 4 Students were set a challenge by their teacher to produce a chemical clock measuring a 20 s time interval. They used an opaque solution that became transparent, allowing a black cross to become visible after 20 s.



The students investigated the effect of temperature on their results and plotted a graph.



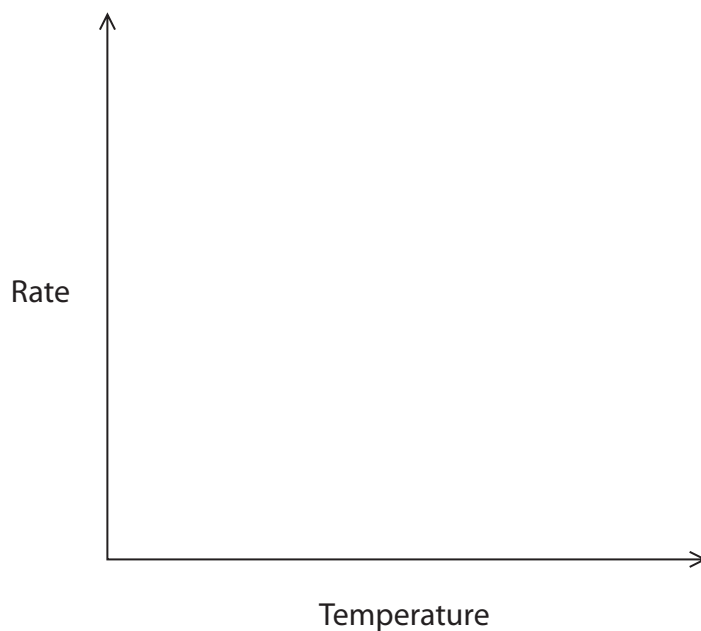
- (a) In this type of experiment  $1/t$  (where  $t$  is time) may be used as a measure of the rate of reaction.
- (i) Calculate the rate at  $15^\circ\text{C}$  to a suitable number of significant figures. Include units in your answer.

(3)



(ii) Sketch a line showing how the rate of reaction varies with temperature for this reaction.

(1)



(b) Evaluate the students' results and decide whether it is necessary to repeat their experiments.

(2)

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.....

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.....

.....

(c) State how you would change the conditions to make this chemical clock measure 40 s at 22 °C.

(1)

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.....

**(Total for Question 4 = 7 marks)**

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- 5 A technician found a bottle of sodium hydroxide solution at the back of a cupboard. The technician determined its concentration by titrating  $25.0 \text{ cm}^3$  samples against  $0.500 \text{ mol dm}^{-3}$  hydrochloric acid from a burette.

The results obtained are shown.

- (a) Complete the titre values.

(1)

	Titration number				
	Rough	1	2	3	4
Final reading / $\text{cm}^3$	24.90	21.25	42.85	21.80	43.15
Initial reading / $\text{cm}^3$	2.30	0.00	21.25	0.50	21.80
Titre / $\text{cm}^3$					21.35

- (b) (i) State why the value from Titration 2 was **not** used to calculate the mean.

(1)

- (ii) Calculate the concentration of the sodium hydroxide solution in  $\text{mol dm}^{-3}$ .

(4)



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(c) Each reading of the burette has an uncertainty of  $\pm 0.05 \text{ cm}^3$ .

Calculate the percentage uncertainty in Titration 4.

(1)

(d) State the colour change that would be seen at the end-point in this titration using phenolphthalein as the indicator.

(2)

From ..... to .....

**(Total for Question 5 = 9 marks)**

**TOTAL FOR PAPER = 50 MARKS**



# The Periodic Table of Elements

1	2	3	4	5	6	7	0 (8)
6.9 <b>Li</b> lithium 3	9.0 <b>Be</b> beryllium 4	23.0 <b>Na</b> sodium 11	24.3 <b>Mg</b> magnesium 12	39.1 <b>K</b> potassium 19	85.5 <b>Rb</b> rubidium 37	132.9 <b>Cs</b> caesium 55	4.0 <b>He</b> helium 2
1.0 <b>H</b> hydrogen 1	12.0 <b>C</b> carbon 6	14.0 <b>N</b> nitrogen 7	16.0 <b>O</b> oxygen 8	19.0 <b>F</b> fluorine 9	20.2 <b>Ne</b> neon 10	31.0 <b>P</b> phosphorus 15	35.5 <b>Cl</b> chlorine 17
27.0 <b>Al</b> aluminium 13	28.1 <b>Si</b> silicon 14	31.0 <b>P</b> phosphorus 15	32.1 <b>S</b> sulfur 16	35.5 <b>Cl</b> chlorine 17	39.9 <b>Ar</b> argon 18	69.7 <b>Ga</b> gallium 31	72.6 <b>Ge</b> germanium 32
63.5 <b>Cu</b> copper 29	65.4 <b>Zn</b> zinc 30	68.9 <b>Se</b> selenium 34	79.0 <b>Br</b> bromine 35	83.8 <b>Kr</b> krypton 36	112.4 <b>Cd</b> cadmium 48	114.8 <b>In</b> indium 49	118.7 <b>Sn</b> tin 50
58.7 <b>Ni</b> nickel 28	58.9 <b>Co</b> cobalt 27	59.0 <b>V</b> vanadium 23	58.9 <b>Cr</b> chromium 24	54.9 <b>Mn</b> manganese 25	55.8 <b>Fe</b> iron 26	58.9 <b>Co</b> cobalt 27	101.1 <b>Ru</b> ruthenium 44
107.9 <b>Ag</b> silver 47	106.4 <b>Pd</b> palladium 46	102.9 <b>Rh</b> rhodium 45	102.9 <b>Rh</b> rhodium 45	101.1 <b>Ru</b> ruthenium 44	101.1 <b>Ru</b> ruthenium 44	106.4 <b>Pd</b> palladium 46	190.2 <b>Os</b> osmium 76
197.0 <b>Au</b> gold 79	195.1 <b>Pt</b> platinum 78	192.2 <b>Ir</b> iridium 77	192.2 <b>Ir</b> iridium 77	190.2 <b>Os</b> osmium 76	190.2 <b>Os</b> osmium 76	195.1 <b>Pt</b> platinum 78	200.6 <b>Hg</b> mercury 80
111 <b>Rg</b> roentgenium	110 <b>Ds</b> darmstadtium	109 <b>Mt</b> meitnerium	109 <b>Mt</b> meitnerium	108 <b>Hs</b> hassium	108 <b>Hs</b> hassium	110 <b>Ds</b> darmstadtium	111 <b>Rg</b> roentgenium
159 <b>Tb</b> terbium	157 <b>Gd</b> gadolinium	152 <b>Eu</b> europium	152 <b>Eu</b> europium	150 <b>Sm</b> samarium	150 <b>Sm</b> samarium	157 <b>Gd</b> gadolinium	163 <b>Dy</b> dysprosium
65 <b>Er</b> erbium	64 <b>Gd</b> gadolinium	63 <b>Am</b> americium	63 <b>Am</b> americium	62 <b>Pu</b> plutonium	62 <b>Pu</b> plutonium	64 <b>Gd</b> gadolinium	66 <b>Dy</b> dysprosium
71 <b>Lu</b> lutetium	64 <b>Gd</b> gadolinium	93 <b>Np</b> neptunium	93 <b>Np</b> neptunium	94 <b>Pu</b> plutonium	94 <b>Pu</b> plutonium	64 <b>Gd</b> gadolinium	70 <b>Yb</b> ytterbium
71 <b>Lu</b> lutetium	92 <b>U</b> uranium	92 <b>U</b> uranium	92 <b>U</b> uranium	91 <b>Pa</b> protactinium	91 <b>Pa</b> protactinium	92 <b>U</b> uranium	69 <b>Tm</b> thulium
103 <b>Lr</b> lawrencium	91 <b>Pa</b> protactinium	91 <b>Pa</b> protactinium	91 <b>Pa</b> protactinium	91 <b>Pa</b> protactinium	91 <b>Pa</b> protactinium	91 <b>Pa</b> protactinium	85 <b>At</b> astatine
102 <b>No</b> nobelium	91 <b>Pa</b> protactinium	91 <b>Pa</b> protactinium	91 <b>Pa</b> protactinium	91 <b>Pa</b> protactinium	91 <b>Pa</b> protactinium	91 <b>Pa</b> protactinium	84 <b>Po</b> polonium
101 <b>Md</b> mendelevium	91 <b>Pa</b> protactinium	91 <b>Pa</b> protactinium	91 <b>Pa</b> protactinium	91 <b>Pa</b> protactinium	91 <b>Pa</b> protactinium	91 <b>Pa</b> protactinium	83 <b>Bi</b> bismuth
100 <b>Fm</b> fermium	91 <b>Pa</b> protactinium	91 <b>Pa</b> protactinium	91 <b>Pa</b> protactinium	91 <b>Pa</b> protactinium	91 <b>Pa</b> protactinium	91 <b>Pa</b> protactinium	82 <b>Pb</b> lead
99 <b>Es</b> einsteinium	91 <b>Pa</b> protactinium	91 <b>Pa</b> protactinium	91 <b>Pa</b> protactinium	91 <b>Pa</b> protactinium	91 <b>Pa</b> protactinium	91 <b>Pa</b> protactinium	81 <b>Tl</b> thallium
98 <b>Cf</b> californium	91 <b>Pa</b> protactinium	91 <b>Pa</b> protactinium	91 <b>Pa</b> protactinium	91 <b>Pa</b> protactinium	91 <b>Pa</b> protactinium	91 <b>Pa</b> protactinium	81 <b>Tl</b> thallium
97 <b>Bk</b> berkelium	91 <b>Pa</b> protactinium	91 <b>Pa</b> protactinium	91 <b>Pa</b> protactinium	91 <b>Pa</b> protactinium	91 <b>Pa</b> protactinium	91 <b>Pa</b> protactinium	81 <b>Tl</b> thallium
96 <b>Cm</b> curium	91 <b>Pa</b> protactinium	91 <b>Pa</b> protactinium	91 <b>Pa</b> protactinium	91 <b>Pa</b> protactinium	91 <b>Pa</b> protactinium	91 <b>Pa</b> protactinium	81 <b>Tl</b> thallium
95 <b>Am</b> americium	91 <b>Pa</b> protactinium	91 <b>Pa</b> protactinium	91 <b>Pa</b> protactinium	91 <b>Pa</b> protactinium	91 <b>Pa</b> protactinium	91 <b>Pa</b> protactinium	81 <b>Tl</b> thallium
94 <b>Pu</b> plutonium	91 <b>Pa</b> protactinium	91 <b>Pa</b> protactinium	91 <b>Pa</b> protactinium	91 <b>Pa</b> protactinium	91 <b>Pa</b> protactinium	91 <b>Pa</b> protactinium	81 <b>Tl</b> thallium
93 <b>Np</b> neptunium	91 <b>Pa</b> protactinium	91 <b>Pa</b> protactinium	91 <b>Pa</b> protactinium	91 <b>Pa</b> protactinium	91 <b>Pa</b> protactinium	91 <b>Pa</b> protactinium	81 <b>Tl</b> thallium
92 <b>U</b> uranium	91 <b>Pa</b> protactinium	91 <b>Pa</b> protactinium	91 <b>Pa</b> protactinium	91 <b>Pa</b> protactinium	91 <b>Pa</b> protactinium	91 <b>Pa</b> protactinium	81 <b>Tl</b> thallium
91 <b>Pa</b> protactinium	91 <b>Pa</b> protactinium	91 <b>Pa</b> protactinium	91 <b>Pa</b> protactinium	91 <b>Pa</b> protactinium	91 <b>Pa</b> protactinium	91 <b>Pa</b> protactinium	81 <b>Tl</b> thallium
90 <b>Th</b> thorium	91 <b>Pa</b> protactinium	91 <b>Pa</b> protactinium	91 <b>Pa</b> protactinium	91 <b>Pa</b> protactinium	91 <b>Pa</b> protactinium	91 <b>Pa</b> protactinium	81 <b>Tl</b> thallium
89 <b>Ac</b> actinium	91 <b>Pa</b> protactinium	91 <b>Pa</b> protactinium	91 <b>Pa</b> protactinium	91 <b>Pa</b> protactinium	91 <b>Pa</b> protactinium	91 <b>Pa</b> protactinium	81 <b>Tl</b> thallium
88 <b>Ra</b> radium	91 <b>Pa</b> protactinium	91 <b>Pa</b> protactinium	91 <b>Pa</b> protactinium	91 <b>Pa</b> protactinium	91 <b>Pa</b> protactinium	91 <b>Pa</b> protactinium	81 <b>Tl</b> thallium
87 <b>Fr</b> francium	91 <b>Pa</b> protactinium	91 <b>Pa</b> protactinium	91 <b>Pa</b> protactinium	91 <b>Pa</b> protactinium	91 <b>Pa</b> protactinium	91 <b>Pa</b> protactinium	81 <b>Tl</b> thallium
86 <b>Rn</b> radon	91 <b>Pa</b> protactinium	91 <b>Pa</b> protactinium	91 <b>Pa</b> protactinium	91 <b>Pa</b> protactinium	91 <b>Pa</b> protactinium	91 <b>Pa</b> protactinium	81 <b>Tl</b> thallium

relative atomic mass  
**atomic symbol**  
name  
atomic (proton) number

Elements with atomic numbers 112-116 have been reported but not fully authenticated

\* Lanthanide series

\* Actinide series



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